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AVIATION.—*Aviation and the war.*[1] C. F. LEE, Commanding Officer, British Aviation Mission. (Communicated by L. J. Briggs.)

I should much prefer to stand here and answer a few direct questions rather than to try to give you miscellaneous information on subjects connected with aviation. But there are representatives here of so many different sciences, men who are in the habit of asking and answering questions on such a variety of topics, that it is probably better that I do not attempt to answer any scientific questions at all on the theory of aviation, especially as my scientific knowledge of it is nil.

Not everyone realizes how long a time it takes to make a service flyer. The average period, from the time that the pupil is brought to the cadet schools of the Flying Corps to the time he is ready to go over-seas and fly over the lines, is about seven months. That is a very considerable length of time, especially in these days of intensive training and preparation, yet the actual training in flying is one of the simplest items. The principal factor to consider in teaching flying in war time is whether it is worth while to spend the necessary time on a pupil. If a country is at peace and there are plenty of machines available, it may pay to stick to a man who will undoubtedly make a flyer sooner or later, for anyone can fly if sufficient time be given to his instruction. But in times of war when, as at the present time, we

[1] Report of a lecture given before the Washington Academy of Sciences on Thursday, March 7, 1918.

have neither a surplus of machines available for flying nor the extra time to spend in training, it is not a practical thing to do. The hard, specialized training which everybody has to come to sooner or later is not only important, but absolutely essential.

Much has been said about "dangerous stunts," frequently with the implication that these are spectacular performances which thrill the spectators but are needlessly risky, and I should like to devote a few words to this matter.

It is quite true that some lives were lost in the earlier days in instructing pupils in what we call "stunting," but it is quite useless to send a man over-seas if he is unable to "stunt." In individual fighting, unless the flyer can really do things better than the German, he is not going to come out alive. For instance, when one machine meets another, each speeds up and goes through every kind of maneuver to get into a good position so as to be able to "get" his opponent. The man who is going to come out alive is the one who can outdo his opponent in flying. It is not a question of "getting away from the German." It is not a matter of getting away at all, but of getting into a good position so that you can down him. He is going to do the same thing as you are, and unless you are able to outdo him in his maneuvers you are going to come out beaten; and unless you are trained to do real stunts (which are really not at all dangerous), you are not going to be able to down him. The danger is not in "stunting;" the danger is in not being able to "stunt."

If a flyer goes over-seas and cannot do these things, then his life isn't worth a "scrap of paper." If he can do these things, and if the time comes when he is absolutely match to match with his opponent, the man who will kill his opponent is the one who can turn his machine about at will and get out of a difficult position. Getting out of the difficult position saves his life, but that is not all; the real problem is to get into a good position so that he can down the enemy, and the downing of the Boche is the thing that every flyer is out for. He is there not to get away; he is there to kill his opponent.

To succeed, the flyer must be taught properly. It may cost one or two lives on this side of the water, but if the men are

taught thoroughly it will mean the ending of these casualties on the other side. What is more important, if the flyer does not know how to "stunt," it will not only mean the death of the pilot himself, which is relatively not so important in view of the fact that so many thousands of men have been killed in this war, but it may result disastrously to a great number of men on the ground. When the man in the air goes down, there may be batteries depending on him for spotting our own fire and the enemy's artillery; there may be infantry regiments waiting to know where the Germans are; and there may be whole divisions waiting for certain information. It is thus absolutely criminal to send a pilot to the front who does not know how to fly, and the only way to make him capable is to teach him to stunt. It is now taught at all the flying schools.

The teaching of stunting is not difficult, but we must have pupils who have a certain amount of knowledge and skill. I will give you one or two instances which we had in the beginning of the war. We were very hard pressed for apparatus and very hard up for machines by the end of 1915. A lot of pilots were sent over-seas after they had been given the best training that the short time would allow, but there were many casualties. Some of them were due to the fact that some of these fellows could not really "stunt" their machines. The Boche would get "on their tail" and they would put their nose down. If the man in the disadvantageous position puts his nose down, the pilot on his tail can do the same and get him very easily. Now, the fellow who can stunt will do some fast climbing, turn, and maneuver himself into a better position from which to attack his opponent, while the fellow who cannot stunt will put his nose down and try to get away and will find himself an easy mark for the enemy. This was very noticeable with raw German flyers.

I want to make it very plain that there is no danger whatever in stunting, and I could show you that with proper training a pupil can be taught to stunt in twenty-five hours. The only danger is in doing it too near the ground, but at 2000 feet there is not a single position that the machine cannot be put into with safety.

The evolution of the machines themselves is very interesting. At the beginning of the war we had only about four small squadrons, of 12 machines each. They consisted of what we now call very old machines. There were some Farman machines, some 2. A and B's, and one or two Bleriots, which at that time were considered very speedy machines. All those machines are now considered too slow even for training. In those days they used to fly under 3000 feet and used to come back with a tremendous lot of bullet holes in their machines, but there were not many casualties. As the war went on, with time and experience the machines gradually were improved, until at the present time we have scout machines that fly 135 miles an hour, machines that will climb 15,000 feet in less than fifteen minutes.

That is the evolution that has been forced on France and England. It is a matter of life and death to the Allies to keep just a little better than the German. But it is very hard to get very much better than he. In practically every case a machine is obsolescent from the time that it appears on a production basis at the front. So it is one huge race to get a machine with a little more maneuverability, a little more climbing ability, and a little more speed. Your defense is not the bullet-proof seat you are sitting in; the only defense you have is the maneuverability of your machine.

To return to the training. When the pupils come to the ground schools they get a certain amount of ground training. They are told what the machine can do, and the detailed operations that are performed by the various parts. They are also given the ordinary subjects connected with drill and military life. After six or eight weeks in training, when they have become soldiers to a certain extent and have acquired a certain amount of discipline, they are drafted to a school of flying.

At this school of flying, according to their temperament, according to how they fly, according to age, and according to their all around knowledge, they are assigned to one of three branches: first, the single-seater scout; second, the artillery-observation squadrons; or, third, the bombing machines for both day and night bombing.

All these subjects are highly specialized at the present time. It is absolutely impossible for a pilot to be an expert in all three subjects. He may be an excellent flyer in a heavy machine but he may fail as a gunner; another pilot may be extremely good in the scouts. All these things require special knowledge and special tactics for teaching them. The pilot in the single seater must be an expert gunner. He must know his gun absolutely thoroughly, but if he can't shoot straight he may as well go home. Some machines have three or four guns. If a gun goes wrong, the pilot must be able to locate the trouble and correct it. He must go through various courses of training, including "stunting" courses, and until he has completed these he is not allowed to go over-seas.

Furthermore, before he goes over-seas he has to be absolutely proficient in what is called formation flying. In former days the machines went out one, two, or three at a time. Nowadays it is of no use to go over alone or in pairs. The machines now fly in sixes, eights, twelves, sixteens, and twenty-fours. They fly together, bunched up and well packed in. If the formation is well packed in no Boche will attempt to touch it. But if one of the pilots drops out of the formation, if his engine goes wrong and his revolutions start dropping and he starts losing height, then the enemy is after him. They wait their time until he is well out of his formation and then his only safeguard is to stunt.

A friend of mine (now Colonel), Jack Scott, used to go out "Hun hunting" by himself. He once was out beyond the lines looking at his own squadron, when a squadron of Boches came between him and his own lines. The only thing he could do was to stunt, and although he got bullets all through his machine, his gun was hit, he had three holes through the seat, and a lot of holes through other parts of his machine, he got away all right. But he said he got so tired of flying around and around that he was almost ready to give up, when one of the enemy happened to come in line, and Scott fired when he saw him on his sights. The Boche went spinning to the ground. That little accident heartened him so that he revived and got away.

There was another fellow, Bishop, who was of the same sort. He went out scouting alone and saw five enemy machines just

getting ready to leave their aerodrome. He flew right down close on top of them and crashed two machines before they left the ground. He then went for the third machine and sent that crashing to the earth. But things were then getting too hot for him so he climbed two thousand feet, where he finally got the fourth one. Then to show his independence he went after the fifth. He got the Victoria Cross for that.

Artillery machines are quite another matter. They have a very hard job and a very interesting one, and it is a job that requires lots of courage because they have to stay in the same place over the batteries and spot the other batteries' fire. They have to keep their eyes on the land, and on a cloudy day the enemy sometimes creeps up on them through the clouds. Generally speaking these men are a little older and are chosen because they have the temperament and are a little more suited to staying over one place and seeing the job out. It is not very pleasant for the men who are accustomed to scouting to have to fly over a certain area and see the same place every day. The artillery nowadays is practically dependent on wireless and aeroplanes for spotting. The total number of aeroplanes you can get now in a definite area is dependent on the wireless you can get into that area without being "jammed," and not on the total number of machines available.

Coupled with the work with the artillery, these aeroplanes also have duties to perform with the infantry, such as contact patrols.

The next class is that of the bombing machines. Bombing is one of the most difficult things there is. It is extremely hard to drop a bomb upon a certain object when an aeroplane is traveling at such an enormous speed and at such high altitudes. If you should go over Washington in an aeroplane, you would be surprised at the many places where you could drop a bomb and do no damage. With your wide streets and avenues it would be very difficult to drop a bomb on any spot where it would do very much harm. If dropped in the street, it would probably do no more damage than to break a few shop windows. If you struck a definite target it would be with a certain amount of luck.

However, it is not all luck. The man who is highly trained will make more hits than one who is not. There is a special course in bombing and a special course on the bombing sights which are attached to the aeroplane.

There was a friend of mine, Harvey Kelly, who went out flying a great deal alone. He was a happy-go-lucky sort of fellow and thought that he could come and go as he pleased. There wasn't anything that he would not try. Once he saw a battery firing and let off one bomb at it. He saw no result so he came up again and let off another one. He happened to look out over the other side of his machine on his third attempt and saw that bomb burst in a village about a mile away from the battery. So you see it is none too easy to drop bombs accurately on any place.

Machines are frequently used nowadays for going up and down the lines, picking off men in the trenches, and generally making things uncomfortable. Nothing is more detrimental to morale than to have aeroplanes continually flying overhead, and the same is true of the observation balloons. The men on the ground think that you can see far more than you can, even when the aeroplane is 15,000 feet above the ground, when as a matter of fact you can't really see any details at all. There is always the possibility of having a battery of guns directed upon them that keeps the men thinking and worries them. If there is a column of infantry moving behind the lines, the aeroplane cooperating with the artillery can always have a battery of guns directed into it. What with aeroplanes flying overhead all day and bombing going on all night, the morale of the soldiers in the trenches has to stand a severe test.

Bombing by night requires a great deal of practice, and night bombing now is a matter to which serious training is devoted. Every night the machines go over the lines and keep the enemy awake as far as possible. After a long spell of trench work, possibly ten days in the trenches, when the men are at the rear resting and playing games, to be continually disturbed at night cannot but have an effect on their efficiency, making them less likely to be of use when they go back to the trenches. That is one object of bombing—to prevent the enemy from having a rest.

I went down to the Texas flying fields about a month ago, and found the cadets there splendid. They are a keen, real good lot, with good discipline, and are an excellent selection of healthy young men. They are all fellows who play games, or ride, or enjoy some sport, and have been well chosen. But they will have to be taught, even at the cost of some casualties.

(The lecturer then showed a series of lantern slides giving views of the front taken from aeroplanes, including the city of Bapaume in flames, the effect of the bombardment of Guillemont at the battle of the Somme, and the bombing of an aerodrome; aeroplane views of England, showing the kind of information that can be obtained by the aeroplane photographer concerning country to be crossed by the troops; the first flying schools in Wiltshire; repairs to planes and engines; the types of aeroplanes and the older types of guns; and various phases of the training of the flyers.)

PHYSICS.—*Note on the periodic system of the elements.* P. V. WELLS, Bureau of Standards. (Communicated by S. W. Stratton.)

The electron theory of atomic structure gives to the periodic system a new significance. This is shown very clearly by the spiral periodic table of Stoney and others as revised by Harkins and Hall. The spiral form has the advantage of being in a plane instead of in space, and thus of naturally representing two coordinates, atomic number and atomic weight.

Chancourtois, the first to discover periodicity in the properties of the elements, used a helix and a period of sixteen. Newlands discovered the period eight, and called his relation "the law of octaves." Mendeleef recognized both periods but considered eight the fundamental period, from valence considerations. This is also in harmony with the electron theory of valence. I have therefore changed the spiral table given by Harkins and Hall to a period of eight instead of sixteen, as is shown in figure 1. The distance from the center represents atomic weight, the elements occurring in angular order of atomic number, which increases

with clockwise rotation. Each group is thus arranged radially, the subgroups being slightly displaced.

The table appears to me to have all the advantages of the space double helix, and is much simpler. It overcomes the artificial-

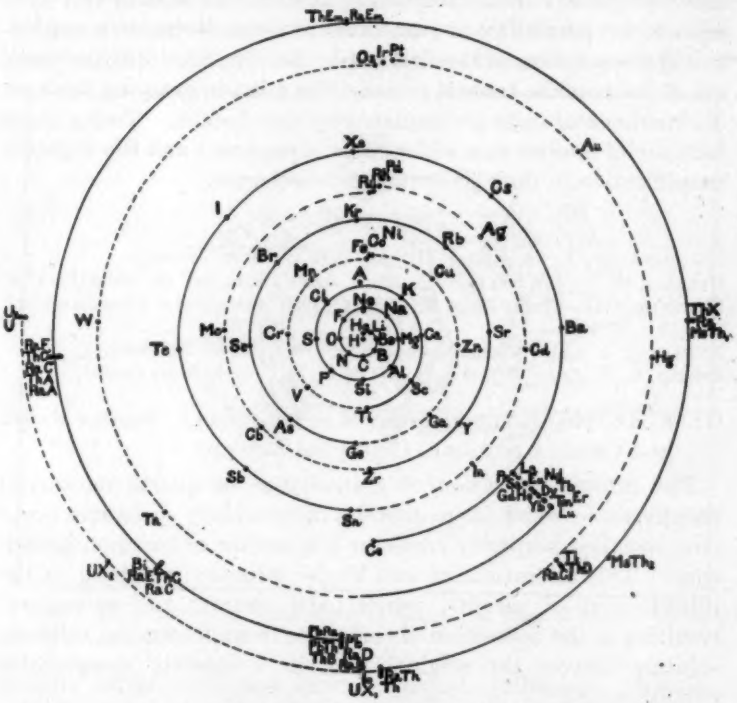

Fig. 1. Spiral table illustrating the electron theory

ity of the spiral of period sixteen, which has two half turns containing no corresponding elements. It brings the subgroups and main groups together, as in Mendeleef's table.

The spiral table is particularly adapted to illustrating the electron theory. Thus each turn represents a ring of eight valence electrons. The vertical axis represents in a general way the transition from positive to negative valence. To the right

are the metals of positive valence, to the left the nonmetals of negative valence, etc.

The table suggests that the elements in the first two series are systems too simple to have the more complicated relationships fully developed. It is interesting, however, to note in this connection the possibility of two forms of neon, perhaps an embryonic foreshadowing of the first triplet Fe, Co, Ni. But the main use of the periodic table is to assist the mind in grasping the host of experimental facts accumulated by the chemist. Today these facts are of interest to a wider circle of scientists and the slightest simplification in their presentation is welcome.

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GEOCHEMISTRY.—*Fluorine in sericitization.*[1] SIDNEY PAIGE and GEORGE STEIGER, Geological Survey.

The intense alteration of granodiorite or quartz monzonite porphyries in which large deposits of secondary chalcocite occur (the so-called porphyry coppers) is a matter of common knowledge. This alteration, of two kinds—primary, resulting in the introduction of sericite, pyrite, and quartz; and secondary, resulting in the deposition of chalcocite from descending sulphate solution—leaves the original rock in a scarcely recognizable condition.

The degree of sericitization is in many places astonishing. Where fractures are numerous and ascending waters have freely circulated, the rock mass may be almost wholly replaced by sericite, quartz, and pyrite, the former two minerals occurring in about equal amounts.

Changes resulting from the descending, oxidizing waters have been in places quite as noteworthy; the sericitized rock has been

[1] Published with the permission of the Director of the U. S. Geological Survey. Mr. Steiger is responsible for the chemical analyses.

altered to kaolin, and here again where fractures are plentiful and the descending solutions have been active, considerable parts of the rock in the aggregate have been altered to this mineral or a closely allied compound.

The formation of sericite from feldspar is usually assigned to the action of either heated water alone or to the action of heated water containing carbonate. As may be observed at many places,

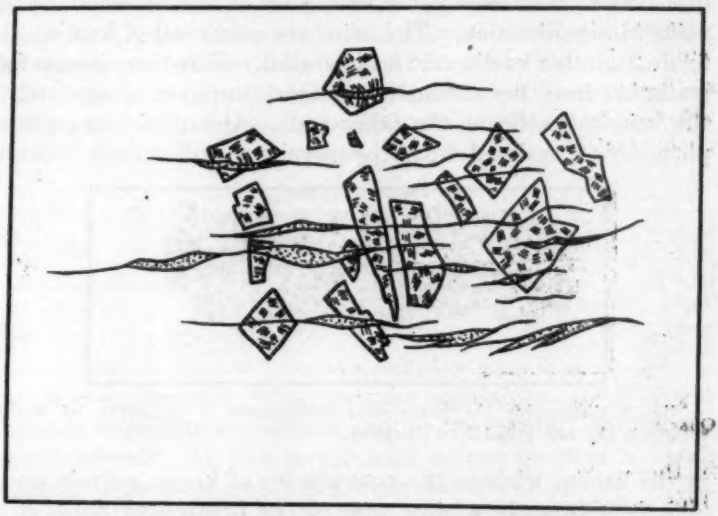


Fig. 1. Illustrating the replacement of breccia by veins of kaolin without movement along the veins.

sericite forms with ease from oligoclase, orthoclase, andesine, and labradorite. According to Lindgren,[2] this fact was first described by Bischof,[3] who also furnished the chemical explanation. The potassium carbonate contained in the water changes the sodium-bearing silicate into potassium silicate, which unites with the aluminum silicate to form sericite.

In the copper deposits at Tyrone, New Mexico—deposits that are typical chalcocite deposits resulting "from secondary enrich-

[2] LINDGREN, WALDEMAR, *Metasomatic processes in fissure veins*. Trans. Amer. Inst. Min. Eng. **30**: 31–608. 1901.

[3] BISCHOF, Chemische Geologie, I, p. 31 et seq; also p. 44.

ment"—the nature of the formation of kaolin below the chalcocite ore bodies seemed to require more than the ordinary explanation, for the evidence is fairly conclusive that quartz in considerable amount, together with the other constituents of the porphyry, has been metasomatically replaced by kaolin.

In figure 1 a series of veins is illustrated, cutting a very brecciated porphyry. The arrangement of the fragments is such that it is evident that there could have been no movement anlog the veins in any direction. The veins are composed of kaolin. In figure 2 another kaolin vein is illustrated. Here there is a perfect gradation from the common sericitized porphyry at one end of the vein to kaolin at the other end. About midway, quartz phenocrysts, residual from the porphyry still remain inclosed

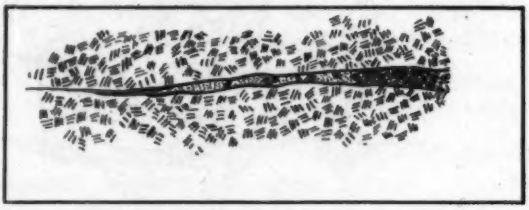


Fig. 2. Illustrating the progressive replacement of porphyry by kaolin. Quartz is the last mineral to disappear.

in the kaolin, whereas the pure masses of kaolin contain none. This is apparently a clear case of the progressive removal of quartz by metasomatic replacement.

In discussing with Dr. Adolph Knopf, of the Geological Survey, this occurrence, which appeared to demand more than the ordinary explanation, Dr. Knopf suggested that perhaps fluorine had been active. In the Tyrone district fluorine occurs in fluorite in veins, at one place in a vien several feet thick and at other places in small veins a few inches thick. It is presumed therefore that it also occurs more generally in small veinlets. That it has not been more generally recognized in small veinlets, however, is natural, for processes of secondary enrichment by waters carrying sulphuric acid are precisely those that would readily attack fluorite and remove it. Nevertheless, it was felt that while fluorine *might* have been present in fluorite in numberless veinlets,

a search for another source was demanded, and sericite was chosen as the mineral most likely to contain it.

It is well known that muscovite mica contains fluorine. It is now recognized that sericite is a form of muscovite, but analyses proving that sericite contains fluorine are surprisingly few. Spurr[4] has argued that fluorine is necessary for the formation of sericite, but his tests were not convincing as to the fluorine content of sericite, though its presence in a specimen (which contained no sericite) to the amount of 0.12 per cent indicated that the waters that altered the rock contained it.

To throw more light on the matter therefore, a part of a narrow replacement vein traversing quartz monzonite porphyry was

TABLE I

Analysis of Sericite Vein

SiO_2	68.11	Na_2O	0.44
Al_2O_3	16.84	K_2O	4.08
Fe_2O_3	0.80	FeS_2	6.68
CaO	0.44	F	0.09
MgO	0.50		
			97.98

chosen for analysis. The specimen contained about equal amounts of sericite and quartz and a little pyrite. No fluorite was visible with the high powers of a microscope, and no other minerals than those mentioned were noted.

The results of the analysis obtained are given in table 1.

The mineral composition of the vein, as computed from the analysis, is quartz, 45.30 per cent, sericite, 46.00 per cent, and pyrite, 6.68 per cent; sum, 97.98 per cent. The analysis was carried out by standard methods. The fluorine, however, was indirectly determined by the colorimetric method, depending on the bleaching effect of fluorine on the color produced by hydrogen peroxide with titanium solution. A qualitative check was made by the old Berzelius method, and the presence of fluorine was proved by its etching effect on glass. All the alkalies and the alkali-earth metals were computed into the sericite. Thus a maximum amount of sericite was figured. The percent-

[4] SPURR, J. E., Geology of the Tonopah Mining District. U. S. Geol. Survey Prof. Paper 42: 232–3. 1905.

age of fluorine in the sericite is practically 0.20. Any lesser amount of sericite would show a higher content of fluorine in the sericite than that calculated. Equivalent silica was allotted to the alkalies and the alkaline earths and the remainder computed as quartz. The failure to sum up to 100 per cent is due to water in the sericite, not determined.

When the fact is taken into consideration that sericite is a very abundant mineral in the rocks of the Tyrone district, the amount of fluorine indicated to be present in the district becomes very significant; first in the rôle it must have played in the primary mineralizing waters, for it is an element of great potency in effecting the decomposition of aluminum silicates, and second, its part in further decomposing the rocks during processes of secondary enrichment on being set free by the action of sulphate waters on sericite.

That fluorine is potent to decompose aluminum silicates is evident not only from the fact that it is used in ordinary analytical work for this purpose, but its use forms the basis of several patents involving the decomposition of feldspar or kaolin. The Doremus process of making potassium sulphate[5] involves the treatment of "finely powdered orthoclase with aqueous hydrofluoric acid." A soluble and an insoluble compound are produced. Both are further treated with sulphuric acid; sulphates are obtained and the fluorine gas and acid recovered.

The Childs process of deriving alumina from kaolin involves the passing of hydrofluoric acid gas, or some other volatile compound of fluorine, for example, silicon fluoride, through kaolin.[6]

It is well known that dilute sulphuric acid solutions will decompose sericite and that kaolin or kaolin-like products originate from this reaction. Fluorine will be set free.

The action of fluorine in descending solutions, whether derived from fluorite or from sericite, might well be somewhat as follows: Fluorite is decomposed by sulphuric acid with the formation of calcium sulphate ($CaSO_4$) and hydrogen fluoride (HF) and hydrogen fluoride unites readily with silica to form water and

[5] United States Patent Office, Specification of letters patent No. 1,054,518, patented February 25, 1913.

[6] Patents Nos. 1,036,453 and 1,036,454, dated August 20, 1912.

silicon tetrafluoride (SiF_4), a gas soluble in water. Silica would thus be attacked and carried off. It is known that

$$SiF_4 + 4H_2O = Si(OH)_4 + (4HF)$$
$$2SiF_4 + (4HF) = 2H_2SiF_6$$

$$3SiF_4 + 4H_2O = Si(OH)_4 + 2H_2SiF_6$$

Thus silicon hydroxide and hydrofluosilicic acid are formed. This latter compound is stable only in water, and is inert so far as attacking quartz is concerned. In the rocks under discussion here, it would probably form alkaline salts. On evaporation of the water, however, silicon tetrafluoride (SiF_4) would again be formed and the more or less insoluble alkaline salts deposited. Whether the silicon tetrafluoride set free would, on recombining with water, again produce the active agent hydrofluoric acid is not known. More likely the process outlined above would be repeated, a certain portion of silicon hydroxide, $Si(OH)_4$, being deposited, and the inert hydrofluosilicic acid going again into solution, to again combine with alkaline bases.

But it is to be expected that these salts will yield to decomposition by acidified waters, as does sericite. And there is reason to believe that fluorine will be again and again set free, so long as sulphuric acid waters are present.

SUMMARY

The intense sericitization common in regions where large deposits of secondary chalcocite occur may be in large measure due to the fact that the primary mineralizing waters contained appreciable amounts of fluorine. The further decomposition of the rocks by descending sulphate waters with the attendant formation of kaolin-like substances may also be accelerated by the presence of the fluorine in the sericite, which is set free by reaction with sulphuric acid. The removal of quartz from veins consisting of kaolin-like matter which apparently has metasomatically replaced porphyry is thus explained.

The presence of fluorine in veins and the determination by chemical analysis of 0.20 per cent fluorine in the sericite of the Tyrone district, New Mexico, support this thesis.

CRYSTALLOGRAPHY.—*Note on the fundamental polyhedron of the diamond lattice.* ELLIOT Q. ADAMS, Bureau of Chemistry.[1] (Communicated by Edgar T. Wherry.)

The space lattice according to which the carbon atoms in diamond are arranged has been established by the work of the Bragg's[2] and has been found not to correspond to any of the previously recognized point systems of the cubic type, having planes of "gliding reflection" and axes of "helical symmetry." To each of the already recognized point systems there corresponds a convex polyhedron capable of filling space, and having a symmetry correspondent to that of the point system. No such polyhedron appears to have been described as corresponding to the diamond lattice. The form of this polyhedron has been worked out and is given below.

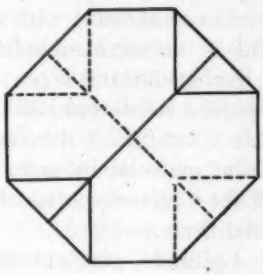
The polyhedron corresponding to the simple cubic lattice is the cube (100); to the face-centered lattice, the rhombic dodecahedron (110); and to the cube-centered lattice, the cubo-octahedron (111), (100), in which the octahedral faces are truncated just enough to make them regular hexagons. Since each carbon atom in diamond is near *four* others, tetrahedral faces will be present. As space can not be filled with tetrahedra, some other face must occur also. This face proves to be that of the rhombic dodecahedron, truncating the tetrahedral faces sufficiently to make them regular hexagons. The polyhedron may be called the dodeca-tetrahedron κ (111), (110). (See figures 1–3).

That diamond is crystallographically holohedral, while the unit polyhedra, as may be seen from the figures, are hemihedral, results from the fact that the mode of arrangement in space of the dodeca-tetrahedra constitutes a sort of twinning. Practically all the elements of the fourth column of the periodic table crystallize in a form similar to that of diamond. If the alternate atoms in such a lattice are different, the crystal becomes hemihedral, as in the case of sphalerite (ZnS). In this case the polyhedra corresponding to the two elements need not be equal in size,

[1] Contribution from the Color Investigation Laboratory of the Bureau of Chemistry, U. S. Department of Agriculture.

[2] BRAGG, W. H., and W. L., X-Rays and Crystal Structure, p. 102. 1915; Proc. Roy. Soc. (A) 89: 277. 1913.

and the dodecahedral faces will be relatively larger on the large figure and small, or even wanting, on the smaller. At the limit, one becomes a tetrahedron of infinitesimal size, while the other reduces to the dodecahedron of the face-centered lattice.



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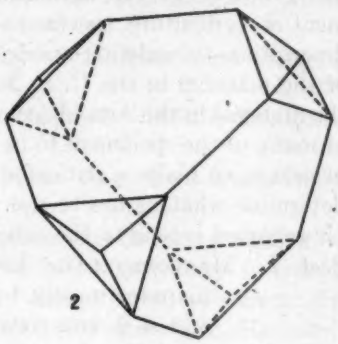

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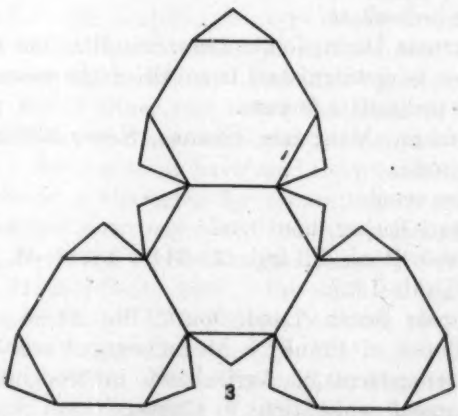

3

Fig. 1. Orthographic projection. Fig. 2. Clinographic projection. Fig. 3. Development of surface; may be used as net for constructing model.

In chalcopyrite,[3] where alternate planes of iron and copper atoms replace the zinc of sphalerite, the axis perpendicular to these planes is unique and the crystal is therefore tetragonal. Replacing alternate iron planes by tin, as in stannite, leaves the system still tetragonal.

[3] BURDICK, C. L., and ELLIS, J. H., Journ. Amer. Chem. Soc. **39**: 2518. 1917.

BOTANY.—*A synopsis of the Chinese and Formosan species of Albizzia.* P. L. RICKER, Bureau of Plant Industry.

In a study of the specimens of Albizzia collected in China by Mr. Frank N. Meyer, agricultural explorer of the U. S. Department of Agriculture, specimens were found not agreeing with the descriptions of existing species, and, as a further examination of the material in the U. S. National Herbarium and a part of the material in the Arnold Arboretum showed the determinations of many of the specimens to be in a state of confusion, it became necessary to make a critical study of the material in order to determine what names to use. All of the Chinese species thus far reported belong to the subgenus Eualbizzia.

Sect. I. MACROPHYLLAE. Leaves 1–4-pinnate, leaflets 3–6-pinnate, mostly broad and large, 2–4.5 cm. broad and 4–9 cm. long, the costa slightly or not all excentric.

A. Flowers pedicellate.

Albizzia bracteata Dunn, Journ. Linn. Soc. Bot. **35**: 493. 1903.

This species is distinguished from all of the nearest related species by its pedicellate flowers.

CHINA: Yunnan; Meng-tsze, Szemao, *Henry* 9997A–E, 4500-5000 feet altitude.

AA. Flowers sessile.

Albizzia meyeri Ricker, nom nov.

Mimosa lucida Roxb. Fl. Ind. (**2**: 344. 1824?) ed. 2. **2**: 544. 1832. Not Vahl, 1807.

Albizzia lucida Benth. Lond. Journ. Bot. **3**: 86. 1844.

Name in honor of Frank N. Meyer, agricultural explorer of the U. S. Department of Agriculture, in recognition of his valuable botanical explorations in China.

CHINA: Yunnan; Meng-tsze, *Henry* 9373A.

Sect. II. OBTUSILOBIAE. Leaves 2–6 (rarely 8–9)-pinnate, leaflets 4–25-pinnate, ovate or oblong, obtuse, mostly less than 4 cm. long, the base broader or scarcely inequilateral, the costa somewhat excentric.

A. Flowers in pedicellate heads, the peduncle axillary or short racemose; corolla often up to 6 mm. long; leaflets 1–3.5 cm. long.

B. Pods noticeably stalked (5 mm. long), gradually tapering at apex and base.

Albizzia kalkora (Roxb.) Prain, Journ. Asiat. Soc. Beng. **66**: 511. 1897.

Mimosa kalkora Roxb. Hort. Beng. 40. 1814, nom. nud.; Fl. Ind. ed. 2. **2**: 547. 1832.

Acacia macrophylla Bunge, Mém. Sav. Étr. Acad. Sci. St. Petersb. **2**: 135. 1833.

The identity of Roxburgh's name was unknown until it was taken up by Prain who doubtless had opportunity to examine authentic specimens. Bunge's name (type specimen from Pang-shan) has been considered by Forbes and Hemsley a synonym of *A. lebbek* L. The latter species is quite widely cultivated in the tropics, the type being from Egypt. The glands on the leaf are variable. In addition to the glands always found between the middle and base of the petiole, another gland is usually found either just below the lower or upper pairs of pinnae, and on some leaves the gland is found below every pair of pinnae. Some authors have used the position of the gland on the petiole as a character for separating species of Albizzia, but its position is entirely too variable to warrant such use.

CHINA: Province of Shantung; Boshan, *F. N. Meyer* 768a (S. P. I. 21969), Sept., 1907. Province of Chili; Pang-shan, *F. N. Meyer* 865a (S. P. I. 22618), Nov. 23, 1907. Province of Fokien; *Dunn's expedition*, May 25, 1905. Province of Hupeh; *Henry* 1605, 2870A, 6203; *Wilson* 511, May, 1900. Province of Kiangsu; near Nanking, *F. N. Meyer* 1448, June 4, 1915. Province of Shantung; Tsingtau, *Zimmermann* 211, 1901; Laushan, *F. N. Meyer* 305, Aug., 1907.

BB. Pods sessile, acute or obtuse at apex and base.

C. Flowers glabrous except tips of corolla lobes.

Albizzia henryi Ricker, sp. nov.

A large shrub or small tree 2.5–6 meters tall; leaves and pinnae 1–2-pinnate; leaflets 5–10-pinnate, thin, glabrous, oblong or

oblong-elliptic, 2–3 cm. long, 1–2 cm. broad, the midvein but slightly excentric; flowers 1 cm. long, many in heads on axillary peduncles 4–9 cm. long, the pedicels 5–6 mm. long, glabrous; calyx 4–4.5 mm. long, glabrous, with shallow teeth; corolla white, puberulent only at the tips of the lobes; pods nearly sessile, 13–14 cm. long, 22–28 mm. wide, coriaceous, abruptly obtuse at both ends, mucronate-pointed; seeds smooth, brown, elliptic, thin, 8–9 mm. long, 4.5–5.5 mm. wide.

CHINA: Yunnan; Meng-tsze, *A. Henry* 10683, in flower May 29, in fruit June 30, 1896. (Type in U. S. Nat. Herb.).

CC. Flowers puberulent throughout.

Albizzia lebbeck (L.) Benth. Lond. Journ. Bot. **3**: 87. 1844.

Mimosa lebbek L. Sp. Pl. 516. 1753.

I have not seen Henry's specimen from Ichang reported by Forbes and Hemsley, but think it probable that it is *A. kalkora*, as are most of the specimens from China that have been named as above. It is doubtful if the true *A. lebbek* is found wild in China except rarely as an escape from cultivation around some of the larger cities. The only apparently genuine specimen I have seen from China was from Hong-kong. *A. macrophylla* Bunge, usually referred here as a synonym, is quite distinct and is a synonym of *A. kalkora*.

AA. Flowers in heads, long pedicelled; heads in subcorymbose racemes; leaflets less than 2.5 cm. long.

Albizzia retusa Benth. Lond. Journ. Bot. **3**: 90. 1844.

This species is distinguished from its nearest relative, *A. pedicellata* Baker, by having its leaflets only 6–10-pinnate instead of 15–20-pinnate as in that species.

FORMOSA: South Cape, *Henry* 992. It is also found in the Philippines.

AAA. Flowers axillary, sessile or very shortly pedicelled, small; corolla 4 or rarely 6 mm. long; peduncles short, fascicled, often in numerous short leafless panicles.

B. Flowers glabrous.

Albizzia corniculata (Lour.) Ricker, nom. nov.

Mimosa corniculata Lour. Fl. Cochinch. 651. 1790.

Albizzia millettii Benth. Lond. Journ. Bot. **3**: 89. 1844.

CHINA: Hong-kong, *Ford; C. Wright* in 1853–56; *Sargent*, Nov. 5, 1903. New Territory, *Mrs. L. Gibbs*, 1909. Lung-chau; Kwang-si, *H. B. Morse* 655.

BB. Flowers pubescent or puberulent.

C. Leaflets 6–8-pinnate.

Albizzia procera (Roxb.) Benth. Journ. Bot. **3**: 89. 1844.

Mimosa procera Roxb. Pl. Corom. **2**: 12. *pl. 121.* 1798.

This species has the costa but slightly excentric and the widest half of the leaflet turned towards the tip of the leaf instead of the narrowest half as is usual in most species.

CHINA: *Henry* 1613.

CC. Leaflets 8–25-pinnate.

Albizzia odoratissima (Willd.) Benth. Lond. Journ. Bot. **3**: 88. 1844.

Mimosa odoratissima Willd. Pl. Corom. **2**: 12. *pl. 120.* 1798.

CHINA: Yunnan; Meng-tsze, *Henry* 9910, 10811A.

Albizzia odoratissima mollis Benth. in Hook. Fl. Brit. Ind. **2**: 299. 1878.

CHINA: Yunnan; Tapin-tze, *Delavay* 658.

Sect. III. FALCIFOLIAE. Leaves many(5–10)-pinnate; leaflets many(10–40)-pinnate, small(5–10 mm. long), often falcate; costa close to the upper margin.

A. Stipules linear, caducous; leaflets 10–20-pinnate.

Albizzia julibrissin Scop. Del. Insubr. 18. *pl. 8.* 1786.

Acacia julibrissin Willd. Sp. Pl. **4**: 1065. 1806.

Forms of this species are occasionally found with the branches, foliage, and inflorescence densely pubescent or even velutinous throughout (*A. julibrissin mollis* (Wall.) Benth.). The commonest form, however, has these parts but slightly pubescent or almost glabrous.

CHINA: Hupeh; *Henry*, without locality, 6185; *Wilson* 792, 1315, 2032 without locality. Chili; Peking, *Sargent*, Sept. 18, 1903; Tientsin, *Meyer* 1001, June 12, 1913.

COREA: Chemulpo, *Faurie*, Sept. 28, 1901; Quelparte, *Faurie* 1695, July, 1907; *Jaquet* 728, without locality, July, 1908.

AA. Stipules broad, coriaceous, caducous; leaflets 20–40-pinnate.

Albizzia chinensis (Osbeck) Merrill, Amer. Journ. Bot. **3:** 575. 1916.

Mimosa chinensis Osbeck, Dagbok Ostind Resa 233. 1838.

Mimosa marginata Lam. Encycl. **1:** 12. 1783.

Mimosa stipulata Roxb. Hort. Beng. 40. 1814, nom. nud.

Acacia stipulata D. C. Prodr. **2:** 469. 1825.

Mimosa stipulacea Roxb. Fl. Ind. ed. 2. **2:** 549. 1832.

Acacia marginata Hamilt.; Wall. Cat. No. 5243. 1832, nom. nud.

Albizzia stipulata Boivin, Encycl. XIX Siecle **2:** 33. 1838.

Albizzia marginata Merrill, Philipp. Journ. Sci. Bot. **5:** 23. 1910.

There are no specimens of this species in the National Herbarium or Arnold Arboretum from China. Osbeck describes it from an island near Wampoa (not far from Canton), where it had probably been introduced from Cochin-china, Siam, Java, or the Philippines, where it is a native.

CHINA: Hong-kong, *Hance;* Hainan, *B. C. Henry.*

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this JOURNAL and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

PHYSICS.—*The work of the National Bureau of Standards on the establishment of color standards and methods of color nomenclature.* IRWIN G. PRIEST. Trans. Illum. Eng. Soc. **13**: 38. February 11, 1918.

This paper deals in a descriptive and enumerative way with the Bureau of Standards "Color Standards Investigation." The present status of color standards and color specification is considered, special emphasis being placed on the lack of standards, established nomenclature, suitable instruments, etc.

A Committee of the Illuminating Engineering Society to cooperate with the Bureau in establishing standards and nomenclature is proposed. I. G. P.

ELECTRICITY.—*A method for testing current transformers.* F. B. SILSBEE. Bureau of Standards Scientific Paper No. 309 (Bull. Bur. Stds. **14**). 1917.

In measuring large amounts of electric power it is usual to employ current transformers which supply to the measuring instruments a small current bearing an accurately known relation to the large current to be measured. Several very accurate methods are available for determining this relation between the two currents but they involve the use of rather sensitive and therefore delicate apparatus.

The present method is intended for the use of the smaller central stations and laboratories which may wish to test current transformers with moderate accuracy but have not the facilities for the more complicated methods. It consists in connecting the transformer under test in series with a standard calibrated transformer of the same nominal ratio, the secondary windings also being connected in series. A measuring circuit is bridged across between the transformers and

serves to carry any difference which there may be in the secondary currents.

The detector should be sensitive to 0.00005 ampere. The moving coil of a commercial wattmeter, the current coil of which is separately excited, is suitable for this purpose.

Two modifications of the general method are described in detail in the paper. F. B. S.

PHYSICAL CHEMISTRY.—*Gas interferometer calibration.* J. D. EDWARDS. Bureau of Standards Scientific Paper No. 316. 1917.

The Rayleigh-Zeiss gas interferometer which finds numerous applications in precision and technical gas analysis is usually calibrated by means of gas mixtures analyzed by chemical methods. The new method here proposed requires only the use of a pressure gage and a knowledge of the refractive indices of the gases for which the calibration is desired. It is based upon the relation between the density and the refractivity of a gas and the relation between the composition and refractivity of gas mixtures. J. D. E.

GEOLOGY.—*Phosphatic oil shales near Dell and Dillon, Beaverhead County, Montana.* C. F. BOWEN. U. S. Geological Survey Bulletin 661-I. Pp. 6. 1918.

The oil shale that promises to be valuable occurs south of Dillon, Montana, at about the same horizon as the phosphate deposits of Montana, Idaho, and Wyoming and, in addition to the oil it yields, contains considerable phosphate. Laboratory tests have shown that the phosphate is not driven off by distillation, and the fact that the shale yields oil on distillation and yet retains a notable quantity of phosphate in the ash presents to the technologist a problem whose solution may be of economic value. R. W. STONE.

GEOLOGY.—*Gold placers of the Anvik-Andreafski region, Alaska.* GEORGE L. HARRINGTON. U. S. Geological Survey Bulletin 662-F. Pp. 17, with geologic sketch map. 1917.

Paying placers have been found on both sides of a greenstone ridge intruded by granitic rocks. Quartz veins related in origin to the intrusives are the source of the gold. Other mineral resources are coal and mineral springs. G. L. H.

GEOLOGY.—*Geologic structure of the northwestern part of the Pawhuska quadrangle, Oklahoma.* K. C. HEALD. U. S. Geological Survey Bulletin 691-C. Pp. 44, with maps and sections. 1918.

This paper describes those geologic features of a portion of the Pawhuska quadrangle, Oklahoma, which bear on the occurrence, discovery, and development of commercial quantities of oil or gas. The rocks that crops out in the area are shown in a generalized stratigraphic section, but the characteristics and extent of certain beds of value in mapping the structure of the region are described fully. The probable character of the rocks to a depth of 4000 feet below the surface is also described, and some evidence is given by graphic representation of well records and stratigraphic sections. R. W. STONE.

GEOLOGY.—*The Flaxville gravel and its relation to other terrace gravels of the northern Great Plains.* ARTHUR J. COLLIER and W. T. THOM, JR. U. S. Geological Survey Professional Paper 108-J. Pp. 5. 1918.

The Flaxville gravel in Montana is from a few feet to 100 feet thick and is composed of well-rounded quartzite and argillite pebbles from the Rocky Mountains but it contains also sand, clay, marl, and volcanic ash. It rests upon a series of plateaus which are cut on the Fort Union, Lance, and Bearpaw formations and which range in altitude from 2600 feet at the east to 3200 feet at the west. Fragmentary fossils collected at 25 well-distributed localities show that the formation can not be older than Miocene nor younger than early Pliocene.

R. W. STONE.

GEOLOGY.—*The Dunkleberg mining district, Granite County, Montana.* J. T. PARDEE. U. S. Geological Survey Bulletin 660-G. Pp. 7, with 1 plate and 1 figure. 1917.

The ore deposits, which have been worked intermittently during the last 30 years and have produced $200,000 worth of silver and lead, occur in limestone, sandstone, and shale of Cretaceous age and also in diorite sills that have invaded these rocks. Except one, which is a contact-metamorphic body of zinc ore, the deposits are simple quartz veins in fissures that follow inclined bedding planes or cut across the sedimentary beds and the sills. Silver-bearing galena and carbonate derived from it are the most valuable minerals, though zinc blende is locally abundant. J. T. P.

TECHNOLOGY.—*The properties of Portland cement having a high magnesia content.* P. H. BATES. Bureau of Standards Technologic Paper No. 102. Pp. 42. January 19, 1918.

The question of the maximum amount of magnesia allowable in Portland cement is one of the most interesting encountered in the study of this complex material. There is still much diversity of opinion. Magnesia in amounts not greater than 8 per cent is believed by many to be harmless, whereas others consider amounts greater than 4 per cent injurious.

It was considered very desirable to investigate the subject because failures of mortars and concrete were attributed to high magnesia content and especially so since all investigations to date have been somewhat at fault.

A series of cements have been burned in the experimental rotary kiln of the Bureau in which the limestone used in the raw material was replaced in part or in whole by dolomite. Cements were thus obtained in which the magnesia content varied from 1.77 per cent to 25.53 per cent. The results obtained show that cements when containing not more than approximately 8 per cent magnesia will produce concretes with satisfactory strength at the end of one and one-half years. At this amount of magnesia, monticellite and spinel (constitutents not present in cement of lower magnesia content) appear; and those cements seem to hydrate with a large increase in volume.

P. H. B.

TECHNOLOGY.—*The determination of absolute viscosity by short-tube viscosimeters.* WINSLOW H. HERSCHEL. Bureau of Standards Technologic Paper No. 100. Pp. 55. November 9, 1917.

The Engler and the Saybolt Universal viscosimeters, which are the instruments usually employed in the oil trade, have such short outlet tubes that the equation for the flow through long capillary tubes is not applicable without correction factors. The literature has been carefully reviewed and further experimental work has been done. The conclusion is reached that water is not a suitable liquid for use in finding the relation between viscosity and time of discharge for short-tube viscosimeters, and that Ubbelohde's equation, and all others based upon it, are seriously in error.

W. H. H.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

WASHINGTON ACADEMY OF SCIENCES

The Board of Managers met on Monday, March 25, 1918. A majority of the committee appointed at the preceding meeting to consider the project of publishing reviews of articles from foreign journals on problems connected with the war reported adversely on the project, principally on account of the lack of editorial facilities for such purposes. A committee consisting of Messrs. MAXON, KNOPF, DORSEY, SOSMAN, and SCOFIELD was appointed to offer plans for making the JOURNAL more systematically and equally representative of the different branches of science, and more useful to the affiliated societies. A committee consisting of Messrs. SOSMAN, KEARNEY, and BARTSCH was appointed to confer with the Board of Management of the Cosmos Club on facilities for the scientific society meetings in the new assembly hall of the Club.

ROBERT B. SOSMAN, *Corresponding Secretary.*

PHILOSOPHICAL SOCIETY OF WASHINGTON

The 800th meeting was held at the Cosmos Club, February 2, 1918; Vice-President HUMPHREYS in the chair; 19 persons present. The minutes of the 800th meeting were read in abstract and approved.

Mr. W. S. GORTON presented a paper on *X-ray protective materials.* The importance of the purpose served by X-ray protective materials is generally recognized. A thorough comprehension of the subject involves knowledge of both the physical and physiological properties of X-rays.

X-rays are generated by the stoppage of cathode rays by matter. They may be classified as soft and hard; synonyms for these terms are "easily absorbed" and "penetrating." It is now known that X-rays are like light waves but of shorter wave length. The penetrating power increases with decreasing wave-length. Methods of measuring quality are as follows: 1, absorption in some substance, generally aluminum; 2, parallel spark gap; 3, wave length; 4, Benoist penetrometer. The last device has been shown (at the Bureau of Standards) to be of practically no use with a modern transformer outfit.

The physiological effects of X-rays may be classified as superficial and deep-seated. The former class comprises X-ray "burns." These burns are due to the absorption of very soft rays by the skin. They

have frequently led to loss of life. Cancer has also resulted from X-ray burns. The latter class comprises the destruction of the lymphocytes and of the tissue forming them, with consequent deleterious effect on the bodily economy. The former class of lesion is the more important practically.

The absorption coefficient of a substance is defined as the quantity λ in the expression:

$$I = I_0 e^{-\lambda d}$$

for the intensity I of a homogeneous beam of X-rays at a point d centimeters below the surface. λ increases with increasing wave length. X-ray absorption is independent of the state of chemical combination of the absorbing elements. Weight for weight, elements of high atomic weight are more efficient absorbers than those of low atomic weight.

Of the elements of high atomic weight lead is, for practical reasons, always used for protection from X-rays. It is used in the metallic state and also as the oxide in glass and rubber. Silk loaded with a lead salt has also been used.

There is no general agreement as to the thickness of lead necessary to give adequate protection. The amount, of course, would depend upon the quantity and quality of the rays against which protection is necessary. For long exposures the German Röntgen Society advocates one of the following: metallic lead, 2 mm. thick; lead rubber, 8 mm. thick; lead glass, 10 to 20 mm. thick.

In estimating the protection offered by protective materials it is much more convenient to ascertain the amount of lead contained in the material than to measure the absorption coefficient. This latter varies with the hardness of the rays used and with the constitution of the beam. Lead is a standard and easily reproducible substance and a knowledge of the lead content of a piece of protective material will enable the user to estimate easily the protection offered at any time when investigations may have rendered our knowledge of the necessary protection more exact.

The absorption of a piece of protective material is due principally to the lead content. The absorption of the remaining constituents is equivalent, for practical purposes, to that of a certain small additional thickness of lead. The whole piece, therefore, is equivalent to a certain thickness of lead. This statement has been verified experimentally. The simplest method for estimating the protection, and the one used at the Bureau of Standards, is to place the substance to be measured on an X-ray plate beside a series of thicknesses of lead. The density of the plate under the material is then matched with the density of one of the thicknesses of lead. This thickness is termed "the equivalent thickness of lead" for the material. It has been shown experimentally that it is independent of all conditions and is the same if a fluorescent screen is used instead of an X-ray plate. The ratio of the equivalent thickness of lead to the thickness of the material is termed the "protective coefficient" of the material.

The Bureau of Standards purchased in the open market twelve pieces of lead glass for X-ray protective purposes. No information could be obtained about them other than that "the protection is adequate." These pieces averaged about 5 mm. thick. The average protective coefficient was 10 per cent, i.e., on the average each piece of glass was equivalent to 0.5 m. m. lead. Two pieces (the most expensive of the lot) had each a protective coefficient of 0.9 per cent and so were worthless for X-ray protection. They were replaced by the vendor.

Samples of lead rubber showed an average protective coefficient of 22 per cent. One piece went as high as 32 per cent.

Correspondence was carried on with several firms relative to the improvements to be desired in protective materials. The results have been most gratifying. It is now possible to obtain materials with the following properties:

SUBSTANCE	PROTECTIVE COEFFICIENT	LEAD CONTENT (BY WEIGHT)	EQUIVALENT LEAD FOR PARTICULAR SAMPLE
	per cent	*per cent*	mm.
Plate glass	18	50	1.16
Rubber	48	94	1.17
Bowl (tube holder)	16	47	1.40 (minimum)

The density of practically every sample of protective material received at the Bureau of Standards has been determined. It has been shown that there is a linear (approximately) relation between the density and the protective coefficient.

Discussion: The paper was discussed by Messrs. SILSBEE, SOSMAN, BRIGGS, HUMPHREYS, and WEBSTER.

Mr. P. T. WEEKS then presented a paper on *The efficiency of production of X-rays.*

The term efficiency of production of X-rays is ordinarily taken to mean the ratio of the total energy of the X-rays emitted either from the tube or from the target to the energy supplied to the tube. The value of this efficiency has been found by actual measurement to be of the order of one tenth of one per cent. It has been found to be nearly proportional to the atomic weight of the target. A simple theory of the method of production of X-rays would indicate that the efficiency should be proportional to the potential applied to the tube, and experiments have verified this conclusion so far as it is applied to the general X-radiation. The manner in which the energy of the characteristic radiation varies with the voltage has been only partly determined.

In general two effects have been used for measuring X-ray energy, the ionization produced in a gas and the heating effect on absorption. In most of the determinations of the efficiency only a small energy input could be used and widely varying results were obtained by different observers. The author used a Coolidge tube with much larger energy input and determined the value by a bolometer method. His results

indicate that the total X-ray energy emitted, including both that of the characteristics and of the general radiation, is approximately proportional to the third power of the potential, or that the efficiency is proportional to the square of the potential. The actual value found for the efficiency agrees with that found by other observers using the same method.

A consideration of the results obtained by the ionization and bolometer methods indicates that only a fraction of the X-ray energy absorbed by a gas is actually used in the production of ions. The fact that the amount of energy absorbed per ion produced is a variable quantity brings into question the validity of the ionization method of measuring X-ray energy. There is need of further detailed investigation of this particular point.

Discussion: This paper was discussed by Messrs. SOSMAN and WEBSTER.

The 801st meeting was held at the Cosmos Club, February 16, 1918; President BURGESS in the chair; 41 persons present.

Mr. H. E. MERWIN presented a paper on *Complementary colors and the properties of pigments.* The paper was illustrated by samples of pigments.

Consideration must be given to refractive index, pleochroism, and shape of grain as well as to the more commonly considered properties of pigments. Diffusing power is determined primarily by refractive index and size of grain. The blue of scattered light is a prominent constituent of some grays and purples. The optimum size of grain of colored pigments depends upon the manner in which the color is diffused —whether by the colored grains or by admixed grains or by a subjacent diffusing surface.

The refractive index of grains of a black pigment should be equal to the refractive index of the vehicle surrounding the grains. A white pigment should differ as much as possible from its vehicle in this respect.

Mixing white or black with a colored pigment, causes a shifting of hue which depends upon several factors, one of the chief of which concerns the character of the boundary between light that is strongly absorbed and that which is freely transmitted.

The coloring efficiency of a pigment in mixtures producing tints may be very different from its efficiency in mixtures producing shades. A given amount of colored material will "go farther" as a glazing color than in mixtures.

Discussion: The paper was discussed by Messrs. SOSMAN, BANCROFT, and PRIEST.

Mr. I. G. PRIEST then presented a paper on *A precision method for producing artificial daylight,* which was illustrated by lantern slides.

Light having a spectral distribution of energy closely approximating that of daylight (black body at 5000° abs., sun at the earth's surface or sun outside the earth's atmosphere), may be produced by passing the light from an artificial source (acetylene flame, vacuum tungsten lamp, or gas-filled tungsten lamp) through two nicol prisms with a crystalline

quartz plate between them, the path of the light being parallel to the optic axis of the quartz, and the thickness of the quartz as well as the angle between the principal planes of the nicols being properly chosen. If three nicols are placed in series in the beam, one quartz plate being placed between the first and second nicols and another quartz plate between the second and third nicols, the approximation to a desired spectral energy distribution may be made still closer.

The rotatory dispersion of quartz has been previously used by others in "chromoscopes," etc. The novelty of the present communication consists solely in showing how the method may be used in producing "artificial daylight," and in presenting precise specifications for producing results.

This method, of course, is not adapted to illuminating large surfaces and so is not a commercial competitor with the blue-glass method or other "artificial daylight." It is, however, very well adapted to use with instruments (photometers, microscopes, etc.) where the quartz-nicol system may be inserted between the eyepiece of the instrument and the observer's eye.

The chief advantages of this method over the blue-glass method are:

1. A much more accurate reproduction of the desired spectral energy distribution. The distributions obtained by the use of blue glass (e.g., Luckiesh's "Trutint" or Corning "Daylight") are always distorted from the desired distribution by a sharp maximum at $\lambda = 570\ \mu\mu$ as well as by a rise in the red for λ greater than $660\ \mu\mu$.
2. Certain reproducibility and definiteness of specifications.
3. Adjustability. By varying the angle between the principal planes of the nicols, the distribution may be slowly changed by known amounts.

Discussion: The paper was discussed by Messrs. SOSMAN, CRITTENDEN, BURGESS, and WHITE.

The third paper, on *A simplified form of Robinson's anemometer*, was presented by Mr. B. C. KADEL. This paper was illustrated by lantern slides.

To begin with, the observer is assumed to have a watch or clock available with which to measure a suitable time interval. The next step is to arrange the anemometer to make electric contact at short intervals, the signal being made audible to the observer by means of a door bell, buzzer, or telephone receiver. The most convenient interval is found as follows:

$$\frac{\text{Distance}}{\text{Time}} = \frac{\text{distance}}{\text{time}} \text{ or } \frac{D}{T} = \frac{d}{t} \text{ in which}$$

D = the linear unit chosen as a measure.
d = the travel of the wind between signals.
T = the time unit chosen as a measure.
t = the time the signals are to be counted.

Whence $d = \frac{tD}{T}$.

Now selecting the customary unit—miles per hour—and letting t be one minute for convenience, we have:

$d = \frac{1 \times 5280}{60} = 88$ feet, which must be the travel between contacts in order that the number of contacts per minute shall be equal to the velocity in miles per hour.

We may now write $t = \frac{dT}{D}$.

We have, therefore, the following rule for the use of the instrument, the same construction answering for any unit of measurement desired:

"The number of signals in 60 seconds equals the velocity of the wind in statute miles per hour.

The number of signals in 52 seconds equals the velocity of the wind in knots per hour.

The number of signals in 27 seconds equals the velocity of the wind in metres per second.

The number of signals in 97 seconds equals the velocity of the wind in kilometers per hour."

It is evident that the customary dial mechanism may be omitted from the instrument entirely, thus eliminating tedious and expensive construction work and lessening the cost. The standard cups, spindle, and bearings have been retained in order to preserve the present relation between wind movement and cup movement; but the framework of the instrument has been made of materials easily available to manufacturers, instead of the tapered tubing used in the old pattern, which requires special orders through the mills for its production.

Gustiness of the wind is indicated in a general way by the variation in the frequency of signal, and the anemometer thus gives information that is lacking in the ordinary one-mile registration.

A similar device has been manufactured by Richard, Paris, for many years, but the contacts are made to actuate a pen arm upon a sheet to produce a continuous record. Mr. Friez, of Baltimore, has marketed an anemometer that makes contact every ½ mile, but it required a table for interpretation of the signals.

The price of the new model is not yet definitely known, but should not exceed $25 for a complete equipment, as compared with $100 for standard anemometer and register.

Discussion: This paper was discussed by Messrs. BURGESS, SCHLINK, HERSCHEL, HUMPHREYS, and BRIGGS.

H. L. CURTIS, *Recording Secretary.*

ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 523rd meeting of the Society was held in the West Study Room of the Public Library on Tuesday evening, March 12, 1918, at 8 p.m. The speaker of the evening was Mr. EDWARD T. WILLIAMS, Chief

of the Division of Far Eastern Affairs, Department of State, who presented a paper on *The origins of the Chinese*. Mr. Williams outlined four theories regarding the origin of the Chinese that deserve examination.

The first, advocated by Dr. L. Wieger, a missionary of the Society of Jesus, is that they originated in the Indo-Chinese Peninsula. His reasons for so believing are, briefly, that

1. The Chinese ideograms have existed since 3000 B.C. and the most ancient represent tropical animals and plants, thus pointing to a tropical country as the place of origin for the race.

But the oldest Chinese ideograms known to the world are not older than 1200 B.C., when the Chinese were already settled in the valley of the Yellow River and in constant intercourse with their neighbors to the south. These ancient ideograms, moreover, represent animals and plants of the temperate zone rather than of the tropics. Those for sheep and cattle are found, too, in many root words, indicating that the early Chinese were shepherds and herdsmen, pursuits not found in tropical countries.

2. Other reasons given for a tropical origin are that the oldest form of the Chinese language is found in southern China today.

3. The Chinese language is purest in the south and grows more and more corrupt as one approaches the north.

4. The Chinese language is tonal, as are the languages of Indo-China, and is therefore most nearly related to these.

It is not necessary, however, to assume a southern origin for the race to account for these facts, which are just as easily explained by the arrival of the Chinese from the north in successive waves of migration, the later comers crowding the earlier further and further towards the south, so that the oldest and purest forms of Chinese would be found just where they are The tonal languages of the Indo-Chinese Peninsula in that case are to be regarded as the languages of the vanguard of the migration.

As a matter of history it is now known that many tribes of Cambodia, Siam, and Burma came from the north, the Tibeto-Burmans from a region as far north as the Tien Shan. Some social or physical change forced these tribes to migrate. The dominant element in the population of Burma did not reach that land until about two or three thousand years ago, while the tribes of Cambodia arrived in their present habitat about 215 B.C. and the Shans, progenitors of the Siamese, ruled southern China until the thirteenth century of the Christian era. The movement of races therefore has been from north to south and not vice versa.

The second theory is that the Chinese originated on the Ame ican continent. This theory does not require much attention. There have been movements of population, it is true, from America to Siberia, even in historical times, and there is cultural and physical similarity if not identity of the peoples on the opposite shores of the northern Pacific. But the tribes of which this is true lie to northeast of China

and differ strikingly from the Chinese in physical appearance, language, and social institutions.

The third theory is held by a number of distinguished scholars and declares that the Chinese are autochthonous and their civilization indigenous. It must be admitted that the oldest existing records of China seem to know no other region as the home of the Chinese forefathers than the valley of the Yellow River, and it is held accordingly that they gave up nomadic habits and settled as agriculturists there in an unknown antiquity and that it was there that they developed their civilization, including their written language. As to the last-mentioned the theory is almost certainly wrong. This civilization, including the use of the ideograms, appears to have been shared by surrounding tribes, from among whom in fact some of their most famous rulers came.

One of these tribes, the Chou, headed a league of nine tribes from the west which subdued the Shang Dynasty about 1200 B.C. These tribes were amalgamated with the earlier and much of the culture of China must be ascribed to the Chou. This fact and the enforced migration of the Mon-Khmer, Tibeto-Burmans, and Shans to the south because of some disturbance apparently in central Asia gives plausibility to the fourth theory.

This theory would place the origin of the race in central or in western Asia. A number of distinguished scholars have held this view. Pumpelly's explorations in central Asia have shown that that region was the seat of an ancient civilization as old as 8250 B.C. Great climatic changes have there converted what was once a moist and fertile land into an arid desert and caused the inhabitants to migrate to other parts of the world. It was this perhaps that drove the Sumerians into the Euphrates valley and that forced other peoples down upon the Tibeto-Burmans and caused the movements of population in China. The earliest Sumerian monuments show that people to have been Turanian. not Semitic, and to have had obliquely-set eyes. Dr. C. J. Ball, of Oxford, has shown that there are striking resemblances between the earliest Sumerian ideograms and those of the Chinese. He has also published a vocabulary of more than a thousand words which show similarities of sound and meaning in Chinese and Sumerian. This lends weight to the theory that both have a common origin and that the peoples were probably related. Most of the mounds of central Asia remain to be explored and it is not too much to hope that, in the not far distant future, evidence may be found establishing conclusively that the Chinese race originated in that locality.

In the discussion which followed the paper Dr. Aleš Hrdlička called especial attention to the importance of the whole subject and the urgent need of archeological and anthropological investigations in these regions. Others who discussed the paper were Dr. John R. Swanton, Mr. James Mooney, and Mr. Henry Farquhar.

The 524th meeting of the Society was held in the West Study Room of the Public Library on Tuesday evening, March 26, 1918, at 8 p.m.

A paper on *The origins of the Italian people*, especially prepared for the Anthropological Society of Washington by Dr. V. GIUFFRIDA-RUGGERI, Professor of Anthropology, University of Naples, was presented by Dr. Austin H. Clark, U. S. National Museum.

The author leaves aside all that relates to the Paleolithic age, in the remains of which Italy is less favored than other regions of Western Europe. A more solid ground is encountered in the Neolithic epoch. From the Lombard plains to the Ionic shore of Italy archeologists have repeatedly found circular foundations of huts half buried in the earth, the remains of dwellings of a Neolithic pastoral people. The huts were hollowed in the ground on purpose, perhaps to afford shelter from the wind, and they were entered either by means of steps, or an inclined plane, or a shaft made close to the hut. In the hollows that remain are found weapons of polished stone and various remains of domestic handicraft, including pottery of advanced technique, form, and decoration.

After describing the burials in natural and artificial caves, the author notes the coming of a new people into Italy from the east. These people came in canoes, and, having crossed the Mediterranean, landed on the southern shores of the Italian peninsula as well as in Sicily and Sardinia. They are called Ligures (Liguri) by historians. The Siculi belonged to the same race as the Ligures, and both were physically of the Mediterranean type.

In western Sicily are found similarities to the Iberian civilization, attributable to "that great wave of influence which touched the coast districts of western Europe, bringing with it the dolmen and the dolmen-pottery." The evolution of the "domus de janas" in Sardinia reached its highest development about 2000–1500 B.C. These burials belong to the "Eneolithic" age in which copper was used a well as stone. Whilst the civilization of the dolmen and megalithic monuments flourished in Western Europe and in the Mediterranean region there was a different civilization in Central Europe. There we find evidences of a people who lived in the lake-regions on pile-structures (*palafitte*), a people whose history is written only in the refuse of their daily lives, covered today by water and peat-bogs. This refuse shows us a primitive pottery, the cultivation of flax and grain, and a pastoral life." . . . . "Toward the end of the second millenium B.C. there took place a great movement of peoples into Italy from the north, and the pine-dwellings of eastern Lombary, as well as the hut-dwellings of the Ligures, were deserted by their inhabitants." Later the Umbrians and the Etruscans entered Italy.

The question as to who were the "*Italici*" seems superfluous to the author "for there were no special people of that name. Italy is a historic formation and all the antecedent races who contributed to her making are equally 'Italian' . . . . The population of the 'Eternal City' was *composita*. It probably embraced from early times the representatives of all the three main races of Europe,—the *H. mediterraneus*, *H. alpinus*, and *H. nordicus*."

FRANCES DENSMORE, *Secretary*.

SCIENTIFIC NOTES AND NEWS

Professor HENRY ADAMS, one of the charter members of the ACADEMY, died at his residence, 1603 H Street, on March 27, 1918, at the age of eighty years. Mr. Adams was born in Boston, February 16, 1838, the third son of the late Charles Francis Adams, American minister to England during the Civil War. He was a professor of history at Harvard University from 1870 to 1877, and was the author of a number of historical works. He was a member of the Philosophical and Anthropological Societies of Washington, and one of the founders of the Cosmos Club. He had been a resident of Washington since 1877.

Professor MARSTON T. BOGERT, formerly Chairman of the Chemistry Committee of the National Research Council, has been commissioned a lieutenant colonel in the Chemical Service Section, National Army. He succeeds Lieutenant Colonel WM. H. WALKER, who has been commissioned as colonel and has been placed in charge of the new gas-shell plant of the Ordnance Department, near Baltimore. Dr. JOHN JOHNSTON, Executive Secretary of the National Research Council, is acting chairmanof the Chemistry Committee.

Mr. EDMUND HELLER, of the American Museum of Natural History, has recently returned from an exploring expedition in western China, near the borders of Burma and Tibet, under the auspices of the Museum.

Dr. E. LESTER JONES, Superintendent of the U. S. Coast and Geodetic Survey, has been commissioned a lieutenant colonel in the Signal Corps.

Dr. WILLIAM H. NICHOLS, of the General Chemical Company, and Prof. C. K. LEITH, chairman of the mineral imports committee, were before the House Committee on Mines and Mining on March 27, 1918, to urge action on the bill giving the President power to guarantee prices for war minerals and to provide for governmental control of such minerals. The members of the Committee on Mineral Imports and Exports, representing the Shipping, War Trade, and War Industries Boards, are C. K. LEITH, POPE YEATMAN, and J. E. SPURR.

Representative B. G. HUMPHREYS introduced in the House of Representatives on March 22, 1918, a bill (H. R. 10954) changing the name of the U. S. Naval Observatory to the U. S. National Observatory, and placing the Observatory under the control of the Secretary and Regents of the Smithsonian Institution. The bill was referred to the Committee on Naval Affairs.

An experimental laboratory has been established in which representatives of the Food Administration and of the Department of Agriculture will cooperate in standardizing war-time recipes and putting them out in the form in which they will be most useful. The work is

in line with the laboratory work which the Department of Agriculture has been doing in testing the nutritive value of foods.

The central hall and auditorium of the National Museum have been turned over to the Bureau of War Risk Insurance, which is also occupying a part of the main floor of the Museum. It will be necessary, therefore, to hold the scientific sessions of the National Academy this year in the hall of the Smithsonian Institution.

The spring meeting of the American Physical Society, which has been held in Washington each year (excepting 1912) for the past twelve years, has been transferred to New York this year on account of the difficulty of obtaining accommodations in Washington. The meeting will be held at Columbia University on Saturday, April 27, 1918.

The annual conference of State Geologists was held in Washington at the U. S. Geological Survey on April 3 and 4, 1918. A reception to the geologists was given by the Geological Society of Washington at the Interior Department on the night of Thursday, April 4.

Dr. F. L. RANSOME, of the Geological Survey, has recently returned from an extended field investigation of the quicksilver resources of the nation.

The following persons have become members of the ACADEMY since the last issue of the JOURNAL: Mr. ANDREW NELSON CAUDELL, U. S. National Museum, Washington, D. C.; Dr. CHARLES WYTHE COOKE, U. S. Geological Survey, Washington, D. C.; Mr. HARLAN W. FISK, Department of Terrestrial Magnetism of the Carnegie Institution of Washington, Washington, D. C.; Capt. EDWARD ELWAY FREE, Inspection Division of the Ordnance Department, War Department, Washington, D. C.; Mr. JOHN B. HENDERSON, 16th St. and Florida Ave., Washington, D. C.; Dr. CHARLES DWIGHT MARSH, Bureau of Animal Industry, Department of Agriculture, Washington, D. C.; Mr. P. L. RICKER, Bureau of Plant Industry, Department of Agriculture, Washington, D. C.

THE PETROLOGISTS' CLUB OF WASHINGTON

The fiftieth meeting of the Petrologists' Club, held on February 19, 1918, at the home of WHITMAN CROSS, seems a fitting occasion to review briefly the work of the Club during its first eight years of existence, particularly as no report of its meetings and discussions has heretofore been published.

The Petrologists' Club of Washington was organized on January 25, 1910, by a small group of representatives from the Geological Survey and the Geophysical Laboratory. The purpose of the organizers was to provide for the discussion of petrologic problems from all points of view, including those of the physicist and chemist as well as those of the geologist and petrologist; to make the discussion much more informal than was felt to be possible in the public meetings of the

Geological Society, which are devoted rather to the reading and discussion of stated papers on geological subjects; and to include in the discussion problems and hypotheses which were still in an unfinished or only partly developed state.

Meetings have been held regularly at the homes of members, on which account the membership has had to be restricted to forty-five. The following brief list gives some of the subjects selected for discussion, and will serve not only to show the kind of problems considered but also to indicate the direction of petrologic thought and research in recent years:

Eutectics, in the laboratory, in the field, and in their relation to rock classification.

The rôle of mineralizers in magmas.

Ore bodies of magmatic origin.

Water as a primary agent in mineral and rock formation.

The relation between igneous activity and movements of the earth's crust, with especial reference to differentiation, the cause of "petrographic provinces," and the hypothesis of Atlantic and Pacific kindred.

The textures of metamorphic rocks.

The tools and methods of petrography.

The weathering of rocks.

The assimilation of rocks by magmas.

The theory of magmatic stoping.

The forms of silica.

The volume change of rocks on fusion.

The mode of escape of mineralizers from deep-seated bodies of magma.

The origin of large intrusive rock bodies.

Isostasy in its relations to petrographic provinces.

The description of minerals, and of sedimentary, igneous, and metamorphic rocks.

The areal distribution of igneous rocks and of their chemical constituents.

The minor constituents of meteorites.

Pegmatitic rocks and minerals.

The secondary enrichment of ores.

Volcanic gases.

The nature and sequence of magmatic emanations, as shown by pegmatites, volcanic emanations, contact deposits, and mineral veins.

The determination of opaque minerals.

The origin of the Kiruna ores.

The sampling and chemical analysis of rocks.

Some of the meetings have been devoted to reviews of petrologic literature, such as Harker's *Natural History of Igneous Rocks* and Bowen's Later Stages of the Evolution of the Igneous Rocks. Short reports of work in progress have also been given, and the discussion of the results from the field and laboratory points of view has never failed to bring out aspects of interest and thus to add to the value of

field observations and laboratory experiments. The hopes of the organizers of the Club have been abundantly justified by the results.

R. B. S.

THE ONE HUNDREDTH ANNIVERSARY OF THE FOUNDING OF THE AMERICAN JOURNAL OF SCIENCE.

Dr. GEORGE F. BECKER, of the Geological Survey, has written the following letter to Prof. E. S. Dana on the occasion of the one-hundredth anniversary of the founding of the *American Journal of Science*.

March 9, 1918.

DEAR DANA:

That a scientific journal should have lasted one hundred years is much: that for a century it should have been conducted by only the founder, his son-in-law, and his grandson is, I believe, unexampled. To me it is appalling to reflect upon the drudgery your family has undergone in order that students of science might teach what they know and learn what their fellows thought. With all possible allowances for pride of achievement and for satisfaction in the respect of every member of the scientific public, you and your kin must have been sorely afflicted with the New England conscience.

Up to about the time of our Civil War *Silliman's Journal* was partly devoted to reproducing in full important papers which appeared in European journals, to which few American readers had access. This was a function on which Louis Agassiz laid stress, considering it however as a matter of course. The younger men of today would incline to regard such a policy as provincial; but it was not. In the first half of the last century the number of scientific workers in the whole world was very limited, and papers recognized as important were reproduced in extenso in most of the great journals such as the *Philosophical Magazine*, the *Annales de Chemie et de Physique*, *Poggendorff*, etc. It was assumed that the representative reader had access to no other similar periodicals and was entitled to the news of the day. Neither were bits of useful information then excluded. In hunting up a translation by Thomas Young in the *Philosophical Magazine* of a paper by Laplace on the construction of curves by their radii of curvature (a method afterwards reinvented by Kelvin), I came upon a serious discussion of how best to keep your razors sharp when your beard becomes wiry!

To me, and I fancy to a large part of the retiring generation, the file of the American Journal seems a monument to James D. Dana. Who but he was industrious enough and nearly enough omniscient to deal with the whole range of scientific thought? Young men in this Survey think of him as a mineralogist, or a geologist, and do not know that he began his career as an instructor in mathematics and in early life achieved fame as a zoologist. Louis Agassiz in 1847 wrote as follows to Milne-Edwards:

"Among the zoologists of this country I would place Mr. Dana at the head. He is still very young, fertile in ideas, rich in facts, equally able as a geologist and mineralogist. When his work on corals is completed, you can better judge of him. One of these days you will make him a correspondent of the Institute, unless he kills himself with work too early."

This prediction was fulfilled twenty six years later. Dana became a corresponding member of the Institute in 1873, not as a geologist or mineralogist, but in the section of anatomy and zoology; and I am told that for the most part the conclusions he drew from his studies of the crustacea nearly 80 years ago are still accepted.

Dana's kindness and helpfulness to his old pupils has often been recorded. This goodness was not confined to them: it was extended to me whom he never saw and it heartened me when I needed encouragement. His very last letter was spontaneous and without other occasion than to inform me of a favorable opinion by H. A. Newton on a bit of my work. He could have saved himself the trouble of writing, but preferred to give pleasure.

Berzelius is said to have remarked that he was the last chemist who would know all chemistry, the idea being that no younger man could catch up. The anecdote is at least "ben trovato," and Berzelius was the man to realize the fact. Dana in 1879 may be said to have been a complete master of geology, but he did not realize his loneliness. Just at the time Clarence King appointed me on this Survey, Dana counseled him to choose no assistant who could not do his own stratigraphy, paleontology, mineralogy, and lithology! Fortunately, King saw the impossibility of setting up a standard that would have excluded everybody but Dana.

The Journal has exerted a potent influence on science in America. Its banner afforded a rallying point for a few idealists when there was imminent danger that Philistinism would gain complete control of a nation struggling with natural resources almost excessive in their abundance. It has been one of the landmarks of our independent nationality, for such a journal could not have thriven in a mere colony. It stimulated the spirit of investigation and helped to guide the development of research along sane and sound lines. For a time it constituted the scientific periodical literature of the country, and if today it is only one of numerous periodicals devoted to science, many of them may well be regarded as offshoots from the *American Journal of Science*.

Salve!

Sincerely yours,

GEORGE F. BECKER.

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